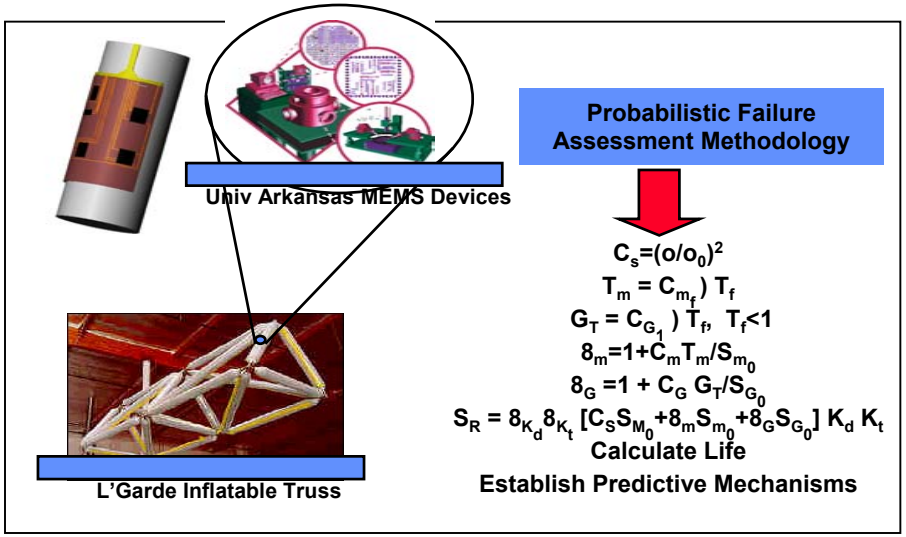
California Institute of Technology

Space Solar Power 2002
PLATFORM SYSTEMS

Objective: Integrate proven technology advances from applicable space flight missions to related large SSP platforms and controls through harvesting of previous space flight missions and acquired data-base.

Approach: Develop probabilistic failure analysis essential to the construction of large structures with emphasis on safety and spacecraft deployment issues, erectable and inflatable, rigidizible modular components, sensors and controls, maintenance and repair sub-systems and high reliability/robust multi-functional systems. Initiate modeling of operational and life parameters as defined by the space environment.



PROGRESS/ACCOMPLISHMENTS

- Defined operating environment and functional requirements for large, long-life SSP structures
- Identification of critical failure modes associated with operational and environmental parameters
- First order operating ranges for simulation input completed

FUTURE MILESTONES

- Perform selected stochastic analyses Sep '02
- Define and configure architectures for interoperability of monitoring, analysis, and prediction Dec '02

DELIVERABLES

- Documented references defining selected operational and environmental parameters selected for model input
- Definition and rationale for selected critical failure drivers
- Assessment of risk and characterization of model parameters and structural/environmental uncertainties
- Representative probabilistic failure model and simulation approach based upon physics of failure
- Failure contours for selected failure modes in specified operating environments
- Structures and controls recommendations for risk mitigation

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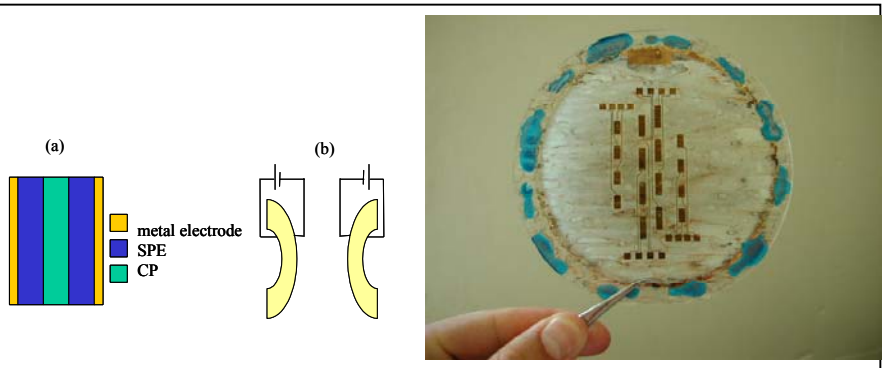
PLATFORM SYSTEMS

ACTIVITY

Investigating Shape Deposition Manufacturing (SDM)

- Permit capability to monitor parameters at critical locations
- Integration of sensor with tooling and production activities
- Thin film and fiber optic sensors are promising candidates



PROGRESS/ACCOMPLISHMENTS

Thin film sensor results

- strain gages characterized in 4 point bending tests with good linearity and no hysteresis
- good agreement with theoretical models and cots devices

Fiber optic sensor results

- Performed temperature and strain monitoring
- Mounted on metallic structures as well as polyamide films
- Potential applications for rapid prototyping of smart materials

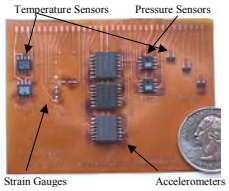
Significant Potentials:

- Embedded sensors and actuators result in robust design at reduced cost
- Capitalize on new design and manufacturing practices
- Sensor locations in previously inaccessible locations
- Use of light signals in sensing makes it possible to develop remote sensing systems for application to large structures control
- Light signals may also permit communications modes to embedded actuators

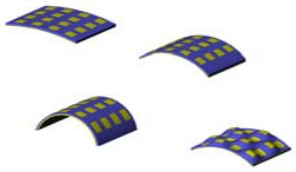
Major Accomplishments

- **Developed techniques for MEMS sensors appliques and mounting on inflatable truss enabling on-article deployment, structural performance and failure monitoring**
- **Configured sensor placement, communications architectures and data acquisition systems to enable follow-on hierarchical, collective health monitoring of large structures**
- **Test and evaluation of sensor performance and function relative to defined truss operating parameters for development of next generation sensor design requirements**
- **Developed design criteria based upon operational/ environmental drivers for inclusion in first order probabilistic failure assessment as a predictive performance method**

- **Test data acquired during active inflation sequence and follow-on stabilization**
  - **temperature (environmental)**
  - **pressure (inflation)**
  - **strain (rigidization)**
  - **acceleration (deployment)**



- **Evaluation of substrate materials and mounting techniques**
- **Analysis of performance of SSP truss test article**
- **Developed second generation sensor package with embedded clusters**
- **Modeling of performance test data for development of diagnostic/prognostic protocols and risk reduction methodologies**



Enable Multi-Functional, Autonomously-Controlled Large Space Structures

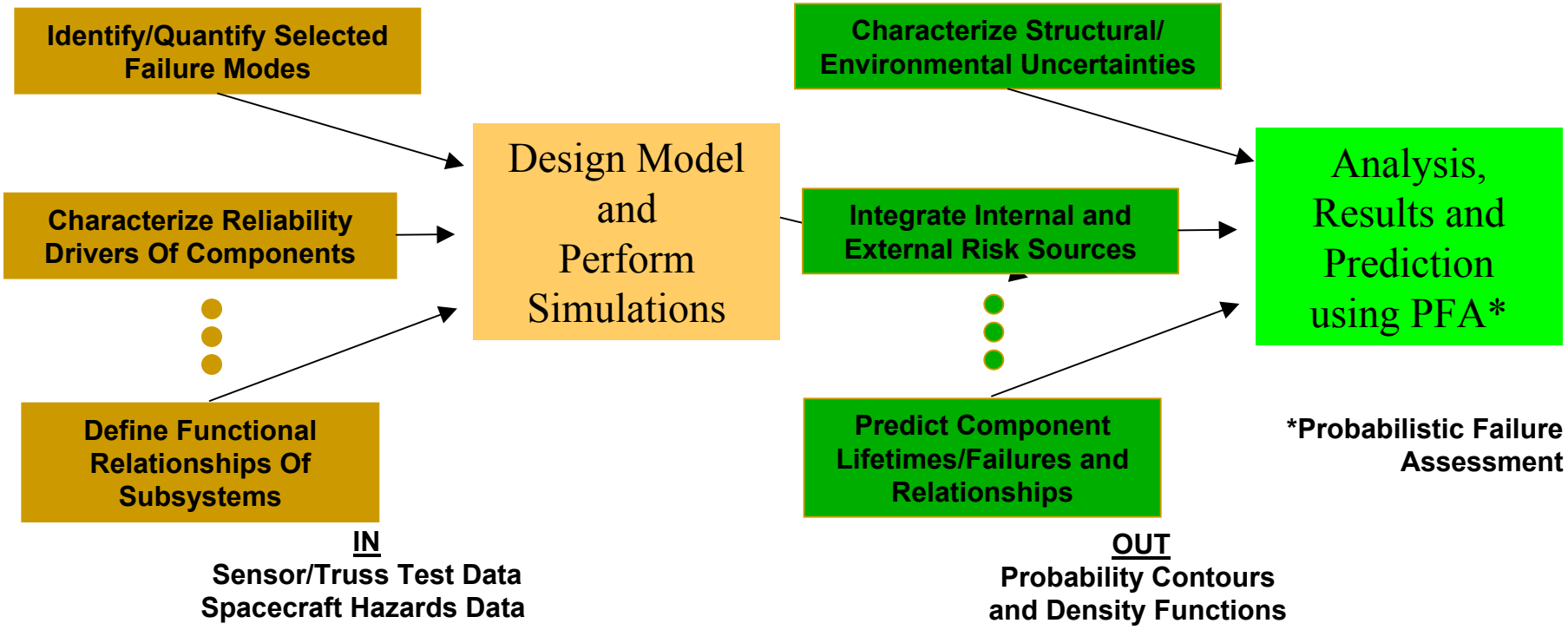
Planned Accomplishments

3rd Quarter

Initiate simulation and modeling with established performance parameters, using selected mission and environmental profiles

4th Quarter

Develop prognostics protocols based on integration of selected design criteria and operating parameters using stochastic analyses



Highlights of JPL Platform Task

- MEMS - Onboard diagnostics and prognostics
  - Develop techniques for MEMS sensors appliques and embedding
  - Configure sensor placement and communications architectures
  - Test and evaluate sensor performance and functionality
- PFA - Probabilistic Failure Assessment and Modeling
  - Establish critical performance parameters for SSP platforms
  - Develop design criteria based upon operational/environmental drivers
  - Implement simulation and modeling and risk reduction methodologies
- Health Management and Control
  - Integrate sensor and operational data to achieve health management
  - Identify applications for sensor/actuator fusion on SSP components
  - Propose sensor/software/control components for flight demonstration

Space Solar Power- Platforms

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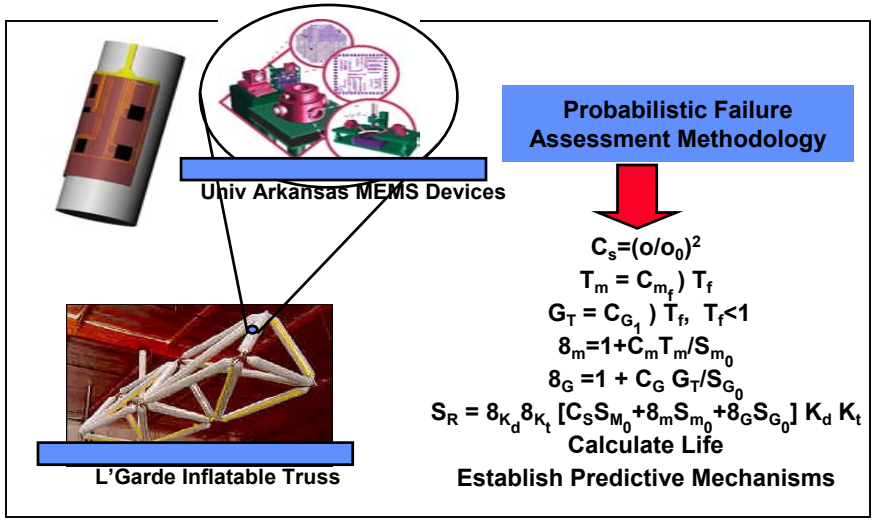
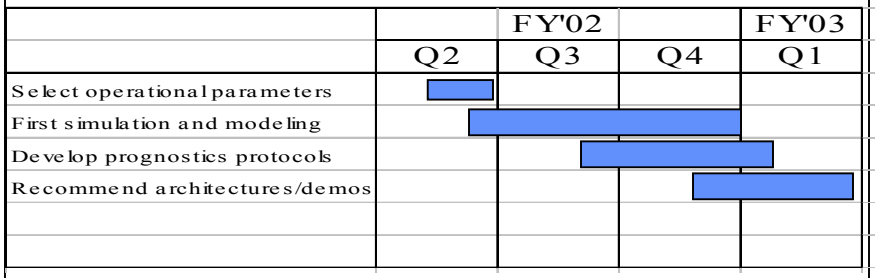


Task Schedule:



Task FY'02 Milestones/Products:

- Identify critical failure modes associated with operational and environmental parameters, Mar '02
- Perform selected stochastic analyses Sep '02
- Define and configure architectures for interoperability of monitoring, analysis, and prediction Dec '02

Resources:

Actuals			*Planned*		
FY'02	FY '03	FY'04	FY'05	FY'06	FY'07
SSP Funding:					
$175	$200	$200	$	$	$
Other-than-SSP Funding:					
$	$	$	$	$	$
FTE's (civil servants and JPL): [Full Time Equivalents]					
0.8	1.2	1.2			
EP's (contractors): [Equivalent Persons]					

Participants:

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